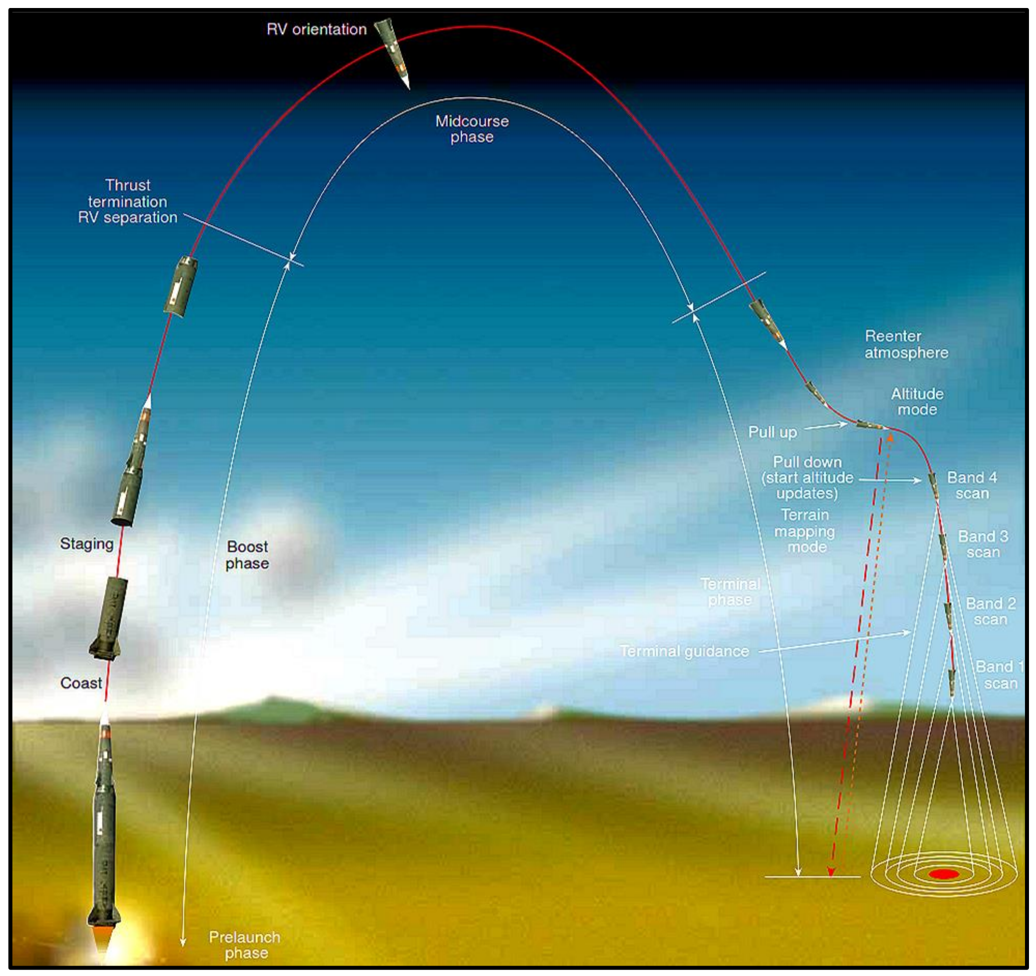
9K81-1 Sz-300V1, 9K81 Sz-300V (SA-12A/B Gladiator)
9K81M Sz-300VM (SA-23 Giant)

The S-300V family is the queen of the army air defense system considering engagement zone and maximal speed of the targets. The Buk-M1 in the '80s had extraordinary capabilities but the S-300V put the bar even more higher. During the design got very high priority the ABM capability but not only against tactical ballistic missiles (up 300 km range) but even against Pershing 1a and II[1] advanced intermediate range ballistic missiles (IRBM). The Mach 6-8 target speed with terminal phase maneuvering capability (similar to Soviet OTR-23 Oka) meant extremely difficult task in addition the whole system had to be fully mobile with ABC protection. For the development of the S-300V 9K81 was appointed the design bureau leaded by V. P. Efremov, the chief designer of the Krug (SA-4) and Osa (SA-8) systems.



Attack profile, target search and identifying capability of the Pershing II ballistic missile.

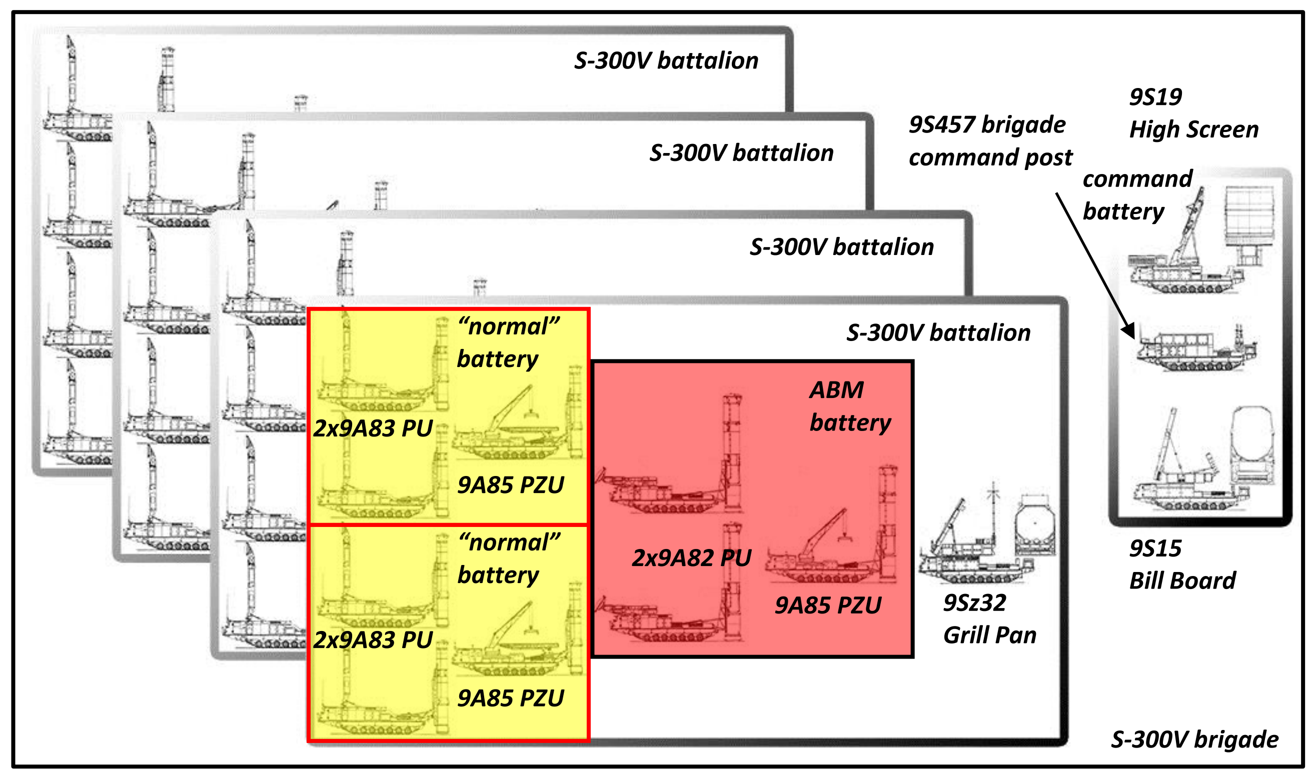
On the Internet fans of Russian technology sometimes make such overstatement the later designed 9K720 Iskander or the OTR-23 Oka are "practically cannot be downed". This is quite an interesting statement while against such targets was designed the S-300V 20+ years before current ABM systems. In fact, as we can judge the publicly available information the Pershing II was even more advanced and difficult target than the OTR-23 Oka.

The long and delayed development of the S-300V system was one of the indications the more and more limited resources of the Soviet Union because of economic issues. Similarly to the 9K37 Buk family the first

[1] https://en.wikipedia.org/wiki/MGM-31_Pershing , https://en.wikipedia.org/wiki/Pershing_II

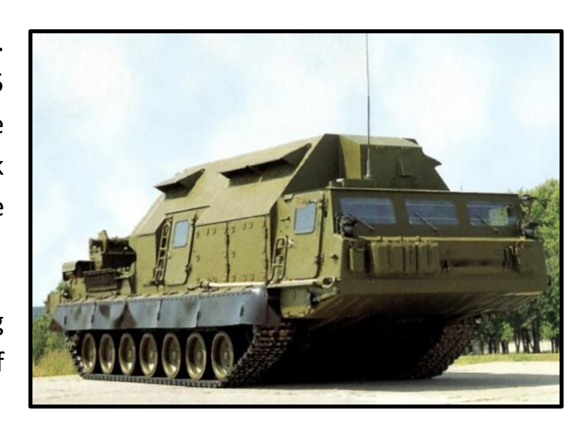
initial variants of the Gladiator entered in service with restricted capabilities and only in minimal quantity. Regardless the S-300V designation is very similar to S-300P PVO SAM family they do not related they are totally different "species". Some of the equipment have similar appearance because of the working principle of the radars but vehicles, the missiles and the guidance are totally different from the S-300P/S-400 family.

The S-300V1 variant entered services without the dedicated ABM battery. The engagement zone of a battalion was "only" 75-100 km depending on the type of the target regardless the burnout speed of the missile made possible achieve much larger range. (The case is exactly the same as the evolution of the S-300P family.) Until end of the Cold War only the S-300V type entered into the service the development S-300VM (V4) could be finished about 20 years later after the Cold War (thanks to the high oil prices).



One S-300V brigade with four battalions, each battalion with two "normal" and 1x ABM battery.

The main elements of the S-300V brigade are the following, let's start with the commanding battery:



The ***9S457 KP*** brigade command post (командный пункт). It tracks and does the prioritization by the data of the 9S15 KO Ozbor-3 target acquisition radar and sorts targets for the battalions. Also the CP's task to establish the datalink connection between the brigade and the Polyana-D4 command post of the Buk-M1 brigade.

The CP is able to track 200 targets, triangulate 70 jamming targets,[2] prioritize 24 targets for engagement, in case of

[2] *Is performed likely with the datalink to Buk-M1 brigades well of Grill Pan radars. Performing with radars of the command battalion seems unlikely because they are close to each other therefore the bearing difference is too small for the process. Another reason is the role of the 9S19 PO radar. If that just for 30 seconds does not search BM targets during this time a Mach 8 speed ballistic missile flies 75 km. Is unacceptable loose the dedicated ABM radar for such a feature.*

detecting incoming IRBM (Pershing-II), the target acquisition/prioritization time is 3 second. Crew of the CP is three officers which indicates high level of automatization similar to American Patriot. Considering the level of solid state electronics industry of the Soviet Union likely this could be one of the cause of the delayed development. The weight of the CP is 39 ton.



The target acquisition radar of a brigade is the ***9S15 KO Ozbor-3*** (Bill Board), (РЛС кругового обзора). It provides the long range situational awareness around the brigade. The radar operates on 10 cm wavelength, in azimuth is mechanically scanned (rotation) in elevation is electronically scanned. The antenna uses 1.5x1.5 degree pencil beam. Crew of the radar is four officers, the weight of the system is 46 ton. The radar has the following operational modes:

1. 0-45 degree electronic scanning in elevation, 360 degree mechanical scanning in 12 sec. Maximum displayed detection range: 330 km Detection range of a fighter size target: 240 km

2. 0-20 degree electronic scanning in elevation, 360 degree mechanical scanning in 6 sec. Maximum displayed detection range: 150 km. Detection range of a fighter size target: 150 km Detection range of a SCUD sized missile: 115 km Detection range of a MGM-52 Lance sized missile: 95 km

3. Sector search mode. [3] 0-55 degree electronic scanning in elevation and in azimuth ±60 degree from a fixed direction in 9 sec. Maximum displayed detection range: 150 km Detection range of a fighter size target: 150 km Detection range of a SCUD sized missile: 115 km Detection range of a Lance sized missile: 95km



The 3D ABM acquisition radar of the brigade is the ***9S19 PO Imbir*** (High Scren), (РЛС программного обзора). The radar operates on 3 cm wavelength (10 GHz), both in azimuth and elevation is electronically scanned. The antenna is able to rotate but when operate it’s only use sector search capability (meaning the mechanical rotating only used to face the antenna to the watched sector). The antenna uses 0.5x0.5 degree pencil beam. Crew of the radar is four officers, the weight of the system is 44 ton. The radar has the following operational modes (scanning within 12,5-14 second):

1. Pershing II mode. Electronic scanning in 26-75 degree elevation and ±45 degree in azimuth Maximum displayed detection range: 175 km

2. SRAM (AGM-69) mode Electronic scanning in 9-50 degree elevation and ±30 degree in azimuth Maximum displayed detection range: 175 km

[3] *Likely this is just a backup mode in case of the failure and loss of the 9S19 PO Imbir (High Screen) ballistic missile search radar. If the Ozbor-3 radar is used is sector search the brigade loses the long range 360 degree target acquisition capability it has to rely on other sources via datalink.*

3. ALCM – SOJ Electronic scanning in 0-50 degree elevation and ±30 degree in azimuth Maximum displayed detection range: 175 km

The main elements of an S-300V battalion are the following:



The ***9S32 SNR*** (Grill Pan), (многоканальную станцию наведения ракет) is the fire control radar of the battalion until terminal phase CW illumination by the TELARs. The Imbir is capable of tracking 6 targets and 12 missiles. The radar operates on 3 cm wavelength (10 GHz), both in azimuth and elevation is electronically scanned, it uses 1x1 degree pencil-beam. The antenna is able to rotate, but it has only sector search capability. Crew of the radar is six officers, the weight of the system is 44 ton. The radar has the following operational modes:

1. CU (ЦУ), target acquisition received from the 9S475 KP. Electronic scanning 6 degree in elevation and 5 degree in azimuth around the target which means around the tracked targets a ±3 and ±2.5 degree zone is scanned which makes possible to detect the launched ARMs from target targets besides the target acquisition capability of the *9S15 KO Ozbor-3* (Bill Board). [4]

2. Tracking missiles with 1x1 degree pencil beam. For missile guidance both of 1st and 2nd mode are needed.

3. AR (автономная работа), autonomous target acquisition. Electronic scanning 0-18 degree in elevation and ±30 degree in azimuth in fact this is sector search. [5] Detection range against different type of target are the followings:

fighter	***Pershing 1/II***	***SCUD size BM***	***MGM-51 Lance***
150 km	140 km	90 km	60 km

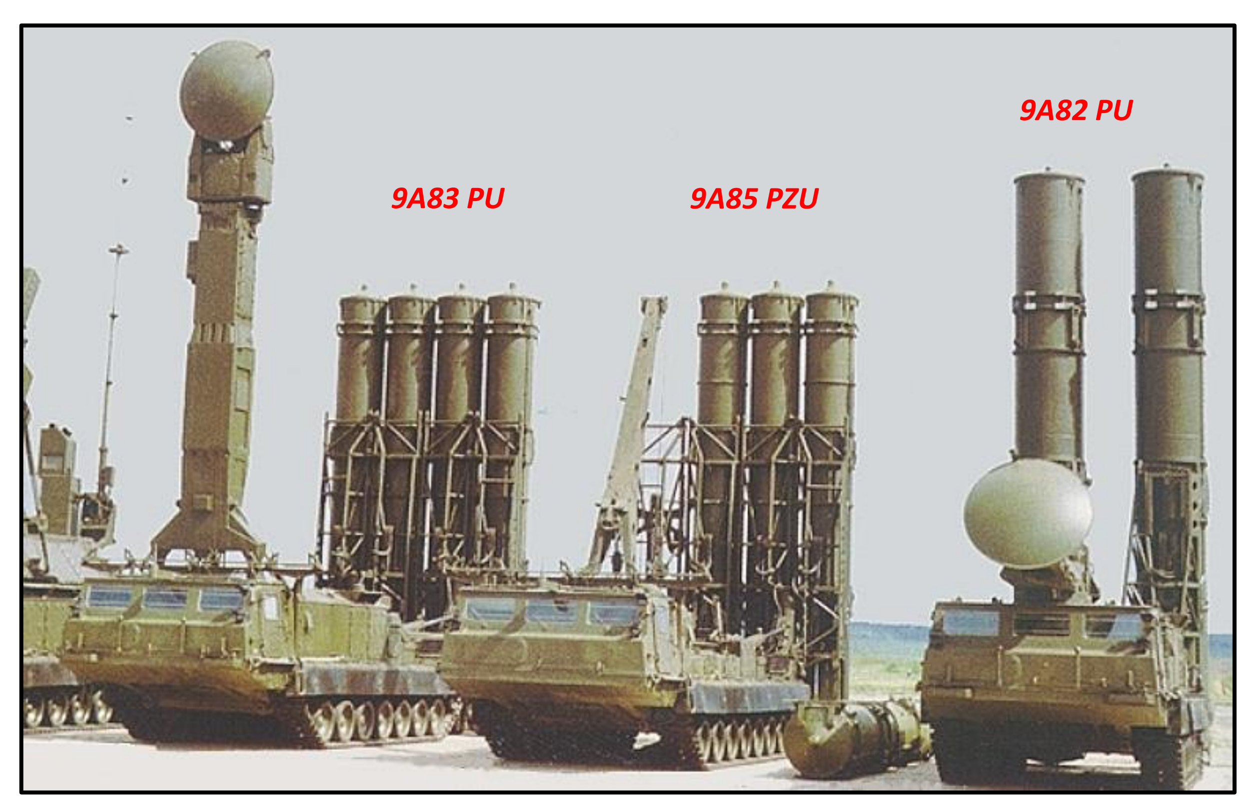
The battalion has two different type of batteries, the normal and the ABM battery. Each battery type has two different kind of TEL and TELAR vehicles.

The normal battery has two 9A83 PU (TELAR, пусковая установка) with four 9M83 missiles, each TELAR has its own target CW illuminator. The crew of the TELAR is three officers. The guidance uses CW illumination in terminal phase the moment of the CW illumination is determined by the 9S32 SNR (Grill Pan) radar. Each TELAR can track and illuminate only a single target but as usual the CW SARH terminal guidance makes possible to guide as many missile on a single target as wished (but practically only two per target). A normal battery has two target channels. Similar to Buk-M1 system the 9A85 PZU (TEL, пускозаряжающие установки) acts as a launcher and as well as a loader for PU vehicles. Reloading time of four missiles is 60 minutes.

[4] Which makes very similar to fire control radar of S-300P the 30N6 RPN (Flap Lid) considering the tracking capability of the radar either.

[5] Likely this is just a backup mode for "just in case" if there in not datalink connection with the brigade CP or with any other high level unit. It is not clear to me the availability of direct link between the S-300V battalion and the Polyana-D4 or the 9S457 brigade CP is necessary for the communication.

The composition of the ABM battery is almost identical with the normal battery just uses different hardware but it also has two target channels. The TEL is the 9A82 PU but has two larger 9M82 type missiles. The crew of the 9A82 is also three officers. The loader vehicle is the9A85 PZU. The vehicles are on the image below (except one.)



On the left is the 9A83 PU launcher (TELAR), on the middle is the 9A85 PZU missile loader and launcher (TEL), on the right is the 9A84 PU ABM launcher (TELAR). The 9A84 PZU is not on the image but it looks similar to 9A85PZU but it has only two larger missile canisters as the 9A82 PU.

The basic element of the S-300V brigade is the battalion because of the 9S32 SNR (Grill Pan) radar. Regardless the basic composition of the Gladiator battalion looks similar to Buk-M1's the situation is different. In theory with limited capability and with IADS datalink the batteries of the Buk-M1 are combat capable because only the TELARs are needed to guide missile the 9S18M1 Kupol radar is not needed. In contrary for S-300V both the TELARs and the Grill Pan radar is needed because of the combined RCG + SARH terminal phase guidance method.

The 9S32 SNR Grill Pan illuminate and track target similar to the S-300P PVO SAM system but in terminal phase the CW illumination is required by the TELARS (9A83 and 9A82 PUs). In case of failure it is destroyed or disabled the Grill Pan the battalion does not have any combat capability. In case just a TELAR fails only a single target channel is gone. The RCG signals are provided by the SNR radar because it is the only unit which tracks both the targets and missile before the terminal phase. When at the end of the ballistic phase missile swaps to CW SARH guidance the Grill Pan still tracks the target to determine the success or failure of the engagement.

The SBR (Grill Pan) can track 6 targets and 12 missiles simultaneously which enough to for the 6 available target channels of a totally battalion and for more than one missiles for one target if it is needed. Comparing to American Patriot much less missile can be on the way towards to targets but the maximal target speed is far beyond the capabilities of the contemporary variant of the Patriot.

The S-300V is very similar to the AEGIS system only difference is the Russian SAM is land based. Both uses terminal CW illumination and phased array (electronically scanned) radars are used for target and missile tracking. Only difference a single AEGIS system has 360 degree coverage with four phased array radar antennas while a single S-300V battalion has much less coverage because of the single 9S32 (Grill Pan) radar. See more detailed the AEGIS system in naval air defense chapter.

The S-300 has two types of missiles the larger and heavier 9M82 and smaller 9M83, the missiles have two stages. The main difference between the two type is the size of the booster stage. The 9M82 ABM missile has the larger section with about 5 second burn time, the second stage burn time is 14 second. The burn time of the second stage is almost the same for both missiles the point or larger booster to provide much more acceleration for the dedicated ABM missiles.

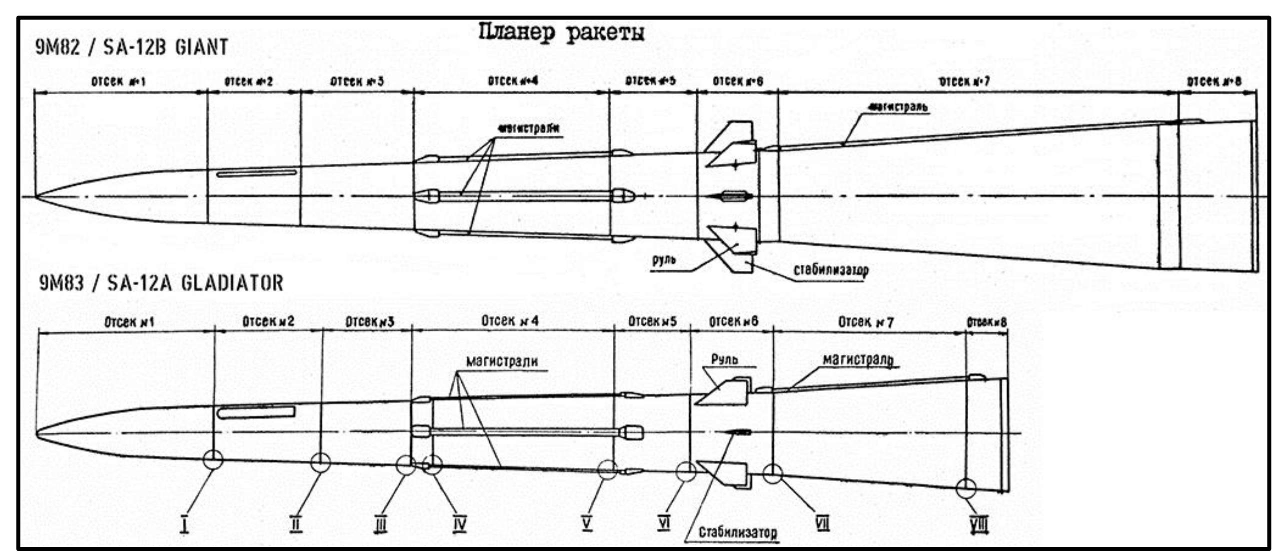
The missile uses combined RCG + terminal SARH guidance by the PU vehicles. Before 3-10 seconds the impact happens the switch in the guidance depending on the type of target and the jamming. The main parameters of the variants of the S-300V are in the chart below:

Type	*Missile*	*Missile weight*	*Rage*	*Altitude*	*target speed*	*missile overload*	*burnout speed*
-	-	*kg*	*km*	*km*	*m/s*	*G*	*Mach*
9K81 S-300V (V2) (SA-12A/B)	9M83 9M82	2290 4685	75 100	0,025-30 0,025-30	1700 3000	20	3,62 5,4
9K81M S-300VM (V4) (SA-23)	9M83M 9M82M 9M82MD	2290 (?) 4685 (?) ?	120-130 200-250 350	0,025-30 0,025-30	1700 3000 4500	30	5,14 7,85

The engagement ranges above concern against airplanes but as we can see on the on target speed the S-300V family has ABM capability against different range of BMs (300 km – 1700 m/s, 1100 km – 3000 m/s, 2500 km – 4500 m/s). These capability limits were reached incrementally by the V1, V2 (these two are the plain 'S-300V' variants) and finally by the V3 and V4 (VM).

	S-300V1 (SA-12A)	*S-300V2 (V) (SA-12B)*	*S-300VM (V3) (SA-23)*	*S-300VMD (V4) (SA-23)*
IOC	*1983*	*1988*	*2013*	*2015 (?)*
maximal range	*75 km*	*100 km*	*200 km*	*350 km*
maximal target speed	*1700 m/s*	*3000 m/s*	*4500 m/s*	*4800 m/s*
maximal range against tactical/theatre ballistic missiles	*40/- km*	*30/40 km*	*30/40 km*	*30/40 km*
max. range of the targeted BM	*300 km*	*1100 km*	*2500 km*	*2500 km*

The weight even of the 9M83 missile is higher than any missile of the S-300P family with about 400 kg. The 9M82 is even heavier with its 4.6 tons - it is more than twice heavier while it has similar range to 48N6DM (250 km) or the 40N6 (380 km) which weighs only about 1.9 ton. The key is the speed of the missiles. The average speed of the missiles of S-300V is higher what increases the engagement zone against BMs. Even with such large speeds the engagement range against BMs are considerable smaller than against about M1.0 speed airplanes.

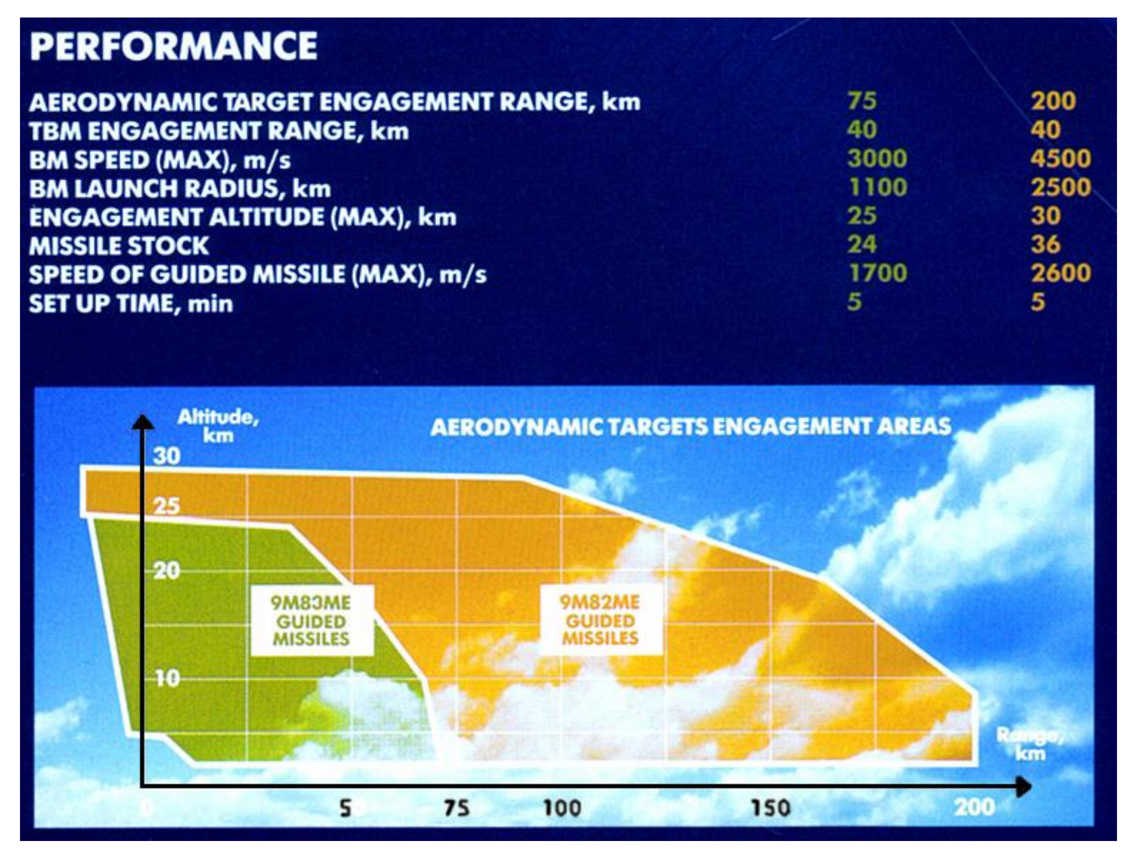


The larger and smaller 9M82 and 9M83 missiles booster stages are different.



Above is the 9M82 missile. The man standing next to the missile gives a good view about the size. Length of it is 9.9 meter with 1.2 maximal diameter.

The engagement envelope diagram below is a bit inaccurate because it shows the range of V1/V2 variant against airplanes in the green zone while in the yellow zone with V3/V4 variant with upgraded missiles but only with the 9M82 missiles without the 9M83M which has only 120-130 km range. The ABM missiles of course can be used against airplanes this is why the 9M82M determines the maximal engagement range.



Engagement zone of the S-300VM

S-300V battery has:

- 6x 9M82 ABM missiles with 2x ABM target channels
- 24x 9M83 missiles with 4x target channels against airplanes (and smaller range ballistic missiles)

S-300V brigade has:

- 24x 9M82 ABM missiles with 8x ABM target channels
- 96x 9M83 missiles with 16x target channels against airplanes (and smaller range ballistic missiles)

Following the end of the Cold War the S-300V also was offered for export to anybody – during the Cold War was not an of option exporting such and advanced SAM system. Comparing to success of S-300P/S-400 the S-300V acquired only very limited success on the market only Venezuela and Egypt bought. It was offered for Finland in 1995 but they found too costly (and overkill) the system comparing to their needs. All previously manufactured variant is Russia have been upgraded to VM (V4) configuration.

As of today (2015), in Google Earth only less than a half dozen S-300V brigades can be identified.

- Kaliningrad, Gvardeysk
- Ukraine, Uman
- Armenia, Gyumri
- Moscow, Naro-Fominsk
- Far East, Tavrichanka

As usual finally are some video and about the system:

http://www.ausairpower.net/APA-Giant-Gladiator.html
https://www.youtube.com/watch?v=AOz7f182Pc4
https://www.youtube.com/watch?v=IAUXkIWOuR4